

Reel House Days and Nights
by
H. Clark Fuller

February, 1976

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2811 -S- Street
Lincoln, NE 68503

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Preface

Writing "Reel House Days and Nights" resulted from correspondence I had with another member of the American Kitefliers Association.

About 40 years after the events narrated in this account I became acquainted with the Association and began to correspond with one or more of its members. After several letters and pictures and descriptions of my work as a kite flier for the U. S. Weather Bureau had been sent, I acceded to a request for a more lengthy and detailed account of the work and my experiences. Thus, this is actually a long letter, and in it are references to incidents and details mentioned in previous letters.

Personnel of the station besides myself are mentioned and identified thus:

Bud--Elwin F. Crandall
Charles L.--Charles M. Lennahan
Charlie--Charles E. Hubbard
Donny--Donvan W. Lewis
Leslie--Leslie A. Warren
Merl--Merl S. Main
Tom--Thomas A. Lawler

---H. Clark Fuller

May, 1982

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Reel House Days and Nights

Perhaps the first spur to my interest in weather was my reading of the book THE BOY WITH THE U. S. WEATHER MAN, a junior science book. Another was an article, "Record Weather" in Scientific American, August 21, 1920.

Since in Ellendale there was a weather station and I knew some of the workers there and saw the kites flying, I became interested in learning about such things. Even then, I suppose, there was the urge to become a weather man.

One of the weather station staff workers lived near by and our family and his were good friends. It was he more than anyone else who made the difference in keeping up my interest in going into that work.

I happened to start keeping a sort of diary of astronomical observations in 1921. Immediately it came to include weather notes as the relationship of clouds to observations of sun, moon, stars and planets was noted. The station was not far from town, a place of about 1,339 population, an easy walk or bike trip, so it was visited frequently by me and some of my friends. One of the latter and I started to plan the making of an anemometer, and of course a rain gauge (or gage, which is what the Weather Bureau called it) and wind vane were obvious projects. My friend was going to be away for part of the summer at a lake in Minnesota, so he and I agreed to take observations for comparison.

Seeing kites in the air, witnessing a couple of lightning strikes on them and other things kept my interest growing. Soon I was spending more and more time at the station and receiving every encouragement. My making a recording anemometer on the pattern of the station instrument interested the Official in Charge and he gave me tips and hints about weather matters. I learned to read the triple register in the office, went on the instrument tower by kind permission, sometimes recorded readings of balloon run observers at secondary stations on 2-station balloon observations and once in awhile launched a kite.

In the summer of 1921 there was an extremely violent wind and rain storm and my desire to see the records and understand them better caused me to continue my study of weather. One thing that made the weather in Ellendale so entertaining to me was high wind, in which I delighted. I liked to see the weather forecast flags which were hoisted onto the flagpole of a bank down town in those days before radio weather information was common.

During school years, on holidays and in summer, I hung around the station about as often as I could. I made a crude barometer, experimented at making a hair hygrometer and then later the anemometer, which was made from a Gilbert weather station set, a telegraph sounder, an alarm clock, some wire and dry cell batteries. From it I derived great pleasure and a bit of knowledge.

Mr. Leslie Warren liked me for some reason and urged me to try for a Civil Service job in the Weather Bureau; but my desires were otherwise just then. After finishing my school course I was away in Minneapolis, Minnesota for a time and while there I took the examination for Junior Observer but failed in it. About a year later, when I was in Ellendale again, I took the exam once more and passed it. I was assigned to the Ellendale station a few months afterward, in June, 1926.

My first summer at the station gave me some unusual experiences. On August 12 we had a kite flight on which I participated, of exceptional interest and excitement. The kites, broken away in a thunderstorm, went up beyond our sight and also beyond our imagination, the instrument making a record of great help in showing updrafts in thunderstorms. The kites were recovered widely separated in distance and direction. A fuller description of this flight is included in the copies of some of my weather scrapbook pages, as well as in the Monthly Weather Review, page copies of which you have.

On August 30, 1926 there occurred the greatest daily rainfall on record at Ellendale up to that time. Our staff was kept busy emptying the rain gauge between showers and watching the recorder during the storm and answering the telephone calls from astonished townspeople.

Some experiences follow in pretty much their chronological order. Still others are told out of that order. This is an easy way for me to tell them and I do hope the account will be acceptable.

On January 7, 1927 two top kites broke away and went to 6 miles north of Edgeley, North Dakota, about 35 miles away.

More than a few of the breakaways were noted in my record by simply saying that they occurred and that kites were recovered. There were others about which there is considerable information.

Likewise all I have to remind me of some other events are notes such as, on July 16, 1927, "We had an afternoon flight, Bud and I, in a rain storm. Just fool's luck that we got them in without a breakaway, though we collapsed one." Or, on December 9, 1927, "We got back the kite we lost on Tuesday," which was 3 days earlier. Or, on March 12, 1929, "Big breakaway out west." Or on several

occasions, "Almost a blizzard all day." Or on April 24, 1932, "We had a risky flight this morning with 410 lbs. pull, over 300 a long time." Or, on August 27, 1927, "We had a breakaway about 5 this afternoon. Had to go out by Guelph and get two of the three kites. My camera, on the second kite, was dragged through a slough but not even dented or hurt." After thorough cleaning, it was all right but I imagine the film was spoiled.

On August 19, 1927 I watched a pilot balloon for 82 minutes and on July 14, 1931 I watched one for 86 minutes, my record I believe. There was not complete agreement on the length of time required to watch a balloon. Some of the men felt that the instruction to follow it as long as it was visible was to be taken seriously. I was one of those, to the discouragement and inconvenience of some of my co-workers at the plotting board, at that time. However, on 2-station balloon observations the advantage to meteorology of very long (high) observations was not questioned. My notes show that on July 24, 1928, we had a 76-minute double-theodolite or 2-station observation.

The purpose of using two stations and sighting the balloon from both of them at the same instant of reading was to use actual triangulation to determine the true height and distance of the balloon geometrically (trigonometrically would be more nearly correct) and not to go on the basis of the nominal ascension rate. On these occasions the nominal ascension rate of 180 meters per minute was used to determine the upper air currents as in a single station run, for the telegraphic report. Then, when the two records were together in the office, the actual computation was made of the true position of the balloon by use of a 20-inch Mannheim type slide rule. It was a fairly long process. Modern pocket or desk calculators would be used now, I suppose. The signal for reading at the distant station was given by use of a shutter device, seen by one observer far away through binoculars and actuated by a rope and pulley arrangement by the person at the plotting board who was recording the readings at the primary station. The binocular-sighting observer then told the observer at the theodolite when the "ready" and "read" signals came across. Each reading consisted of one each of the azimuth, or horizontal, and elevation, or vertical scales on the instrument. A theodolite is a special telescope well adapted to such observations.

Sometimes an observer saw a star in the field of view. It is known that some observer, careless in his attention to a vanishing balloon mistook the star for the balloon and followed it for some time in error. The man at the plotting

board would then have a very odd path to chart and sometimes would call off the observation when it was obviously leading nowhere. In sighting balloons in the sky we discovered that it was easy to see the planet Venus in broad daylight at its brighter phases.

In reading through my *diaries* I was surprised to find out how many night flights I was on and by no means were all of them mine. I have no record or memory of a breakaway at night, though it may have happened. We rarely put out many kites at night for various reasons, one being that we were literally groping in the dark and didn't know what was up there. Knowledge gained from daylight flights sometimes helped us to tell on a night flight that we had a "float-out." This was a long line of kites all on the same level, on the top of a stratum or layer of wind, immediately above which there was little wind or none. Upon reeling in on such a line of kites often the kites would rise up through the stagnant air and catch a wind above it and keep pulling so we could reel out for greater altitude. Probably some of our breakaways resulted from such a situation, the upper wind being too strong for the amount of kite surface in it.

On Friday, December 30, 1927 we were told by telegraph to start a 36-hour kite flight series at 7 p.m. that day. That meant arranging day and night shifts, a pilot balloon run every six hours and consecutive flights of a few hours each for 36 hours, until noon on Sunday, New Year's Day. Whether we made the balloon runs I don't remember but I think several of us remember that series. We usually worked in pairs on 3-hour shifts. Leslie and I worked the first 1 to 4 a.m. shift on Saturday and then 10 a.m. to 1 p.m. and then 7 to 10 p.m. shift. After that we worked an additional shift 10 p.m. to 1 a.m. to arrange it better for some others. The kites went well, but some other things did not, and the weather was terrible. Throughout the series there was some snow, at least blowing, it was 10 to 14 to 20 below zero and the wind was 30 to 45 m.p.h., and of course dark two nights. This was about the worst weather in which kites would fly. More wind would have been too strong and, of the cold--well, I guess that had to be taken as it came. Of wind-chill index we had not heard, but we knew it was a chilling wind.

The reel house had a small back room closed off with a door from the reel, and a larger door for the wire. The operating part of the building was open to the air like that of an astronomical observatory, but for a different reason. When we could, we crept back into that small room, where we sometimes had some heat. On this shift, the last of the 10 p.m. to 1 a.m. shifts, we had a small radiant gasoline heater. Someone had had the good idea to help us keep warm on

this cold series. Leslie tried to get the heater going but, as it was new to us, we had poor success. When it flared up alarmingly, he rushed out with it and dropped it outside on the ground. We both scampered away waiting for it to explode. But it did not and so we went back and tried to resume where we'd left off. In rushing out, Leslie had accidentally kicked the kite meteorograph out of the door. It was the one we were preparing for the start of a flight. So we had to get another instrument ^{and} go through the procedures with it. After about an hour and a half lost time, we got a flight started. Shortly thereafter we were relieved by the oncoming shift folks. We walked to town about 2 a.m. in the -15° cold and snow and wind. I still remember that rather well. It was a long 3/4 mile. After that I had New Year's Day off, a holiday well earned.

Only in cases like the above, when flight conditions of wind, precipitation, cloudiness, etc., were favorable, if you could call it that in such a case, were flight series completed. More often than not the conditions changed and the entire time could not be used. I recall one such when, after about 18 to 24 hours and during daylight, the wind rapidly died out and we had to hurry to get the kites out of the sky before they fell. As I had explained in an earlier letter, the reeling in had to be stopped each time a secondary kite rope was detached from the wire. Failing wind made such occasions rather hectic at times.

You might wonder if we ever had too much wind for flying kites. Yes, indeed we did, not very often but more than a few times. My record mentions October 27 and 28, 1931 as two days together on which there were no flights for that reason. There were other times when blizzard winds were too strong. On January 19, 1928 my note says it was the windiest day for over a year, all day long 40 to 50 m.p.h. and twice 52 m.p.h. Incidentally, the anemometer was of the recording, not the indicating type, and did not show peak velocities on a dial. On the triple register record the maximum velocity was the speed for a full five minutes; the extreme velocity the speed for 1 mile of wind. Gust velocities were not indicated or known.

One sample of winter weather and what we did about it and in it is the following in recorded notes: December 3, 1927, lots of snow, 4, 18 below this morning. 6, almost a blizzard all day. I stayed from 6 to 6 at work (6 a.m. to 6 p.m.). 9, 25 below at 3 a.m. (thermograph record, not observed) We got back the kite lost on Tuesday (the 6th). 10, again -23° 14, another bad day for snow and wind. 15, We all stayed at the station over noon. Too hard going to come in and go out twice. 17, another cold, windy day. The G. N. (Great Northern) hasn't been in for 3 days. 22, Four of the force went skiing on a straw stack near the station. 25, no flight in a.m. I came home (Christmas Day) from 9 to 2:30. After the p.m. balloon run flight till 7:30 p.m. 27,

we skied after work and made a jump to ski over on the straw stack. 30, Cold again. We got news about starting a series that night. That's the way we got into the series previously mentioned.

On April 19, 1928 there occurred the strange and entertaining incident of the rising vapor swirls, described in some detail in copies of scrap book pages accompanying this story.

January 1929 was the coldest month on record at the Ellendale station at that time, the mean temperature for the month being -2.2°F . February 1 was the tenth consecutive day with temperatures below zero all of the time. But later on a cooperative observer in Ellendale showed that in February 1926 the mean for the month was -9.3° . But in that February 1929 on the 19th I did find out what -36° felt like. It was calm then, as it usually was when very cold.

One remark made of winter weather was that there was no wind so cold as the north end of a south wind. So it seemed many times there on the plains. All night long the winter wind would blow from the south, not strong but moderate and the early morning would be extremely cold. Then occurred some of the best mirages, really difficult to describe adequately. Our kite flights on such days sometimes required taking the head kite out a long way, a quarter-mile, perhaps, to get it reeled up out of the calm surface air. The record usually showed a big inversion with the temperature of the air a few hundred meters above the ground much warmer than that at the surface. The inversion produced the mirage. A few hours after dawn the surface air would warm up and the kite flight record showed no more inversion on the way down from the sky.

On April 28, 1929 we put up the first of the limited-height sounding balloons which were to give us upper air data on days when there was not enough wind to loft kites into the air. We let it go with great expectations. But it fooled us, inexperienced as we were. Our expectations were that it would land 4 or 5 miles away. It went out of sight, presumably 15 miles away or more. The next day was spent by some of the staff in searching. No luck. We felt pretty bad. Complete mystery, was our thought.

While waiting--not anxiously--for another calm, flightless day, we considered the boon that such ascensions were to be to us. No flight in the morning, especially on a day of otherwise good weather, meant keeping watch on the weather hour after hour. Those whose task it would be to put up a flight, should conditions develop, could go home to town but could not stray far nor consider themselves free as long as a flight might possibly be made, morning, afternoon, or early evening. The afternoon pilot balloon run sometimes indicated a good

chance but often it did not, so more waiting and sometimes trying, as often failing as succeeding. Lots of wasted time.

On May 14 we received news that our balloon had been found on the day we released it, near Southshore, South Dakota, about 95 miles as the crow--or in this case the balloon--flies. At another time we received back from Clitherall, Minnesota a balloon we had released 15 days earlier. That was about the same distance.

Those were unusual experiences, however. Much of the time we were quite successful and were saved the wasted time waiting to make a flight. But there were conditions in which we could use neither kites nor balloons. That is one reason the airplane observation flights were instituted some years hence.

In a previous letter I wrote about our experience in finding our would-be helper releasing the small locator balloons which we used in sighting the sounding balloon on the ground.

Ordinarily, when we recovered the small locator balloons, we deflated them for reuse. This was done by untying the neck of the balloon and, holding it against one's body, squeezing out the gas. Once when one of them was being deflated by my co-worker Charlie who was near to me, I heard a curious sound and looked around to see Charlie's hands and eyebrows singed. It seems that the hydrogen, coming out of the balloon downward against the hot overalls in the very warm sunlight had ignited and flared up, to his astonishment and mine. Maybe a static spark was generated somehow. We never understood it, but were careful afterward.

Odd things happened in the upper air, too. Some of the sounding balloons burst and one or two exploded. The bursting we understood as a constant possibility, since ascension allowed them to stretch, but the explosions we found puzzling. The parachutes usually were not damaged by the bursting or exploding and ordinarily the instruments were lowered safely. We were a little surprised to find that after the parachutes had been in some fields for a while they had small holes cut in them. They were silk and evidently food for grasshoppers.

On November 19, 1930 we had some "weather," as some people say when they mean only the bad kind. Sleet broke the power line to the station so we had no light or power after 7 a.m. The power company fixed up the line the next morning but soon afterward the pole holding two transformers fell and broke in two places, putting the station out of power again. Lines were down all around, but the town still had power. Snow began again that afternoon. A note tells me that on the 25th a 60 m.p.h. broke 9 years' record and there was snow with

it. During those days the radio stations were used, calling to each other through the day with train dispatches, weather warnings and emergency messages.

The next day was Thanksgiving Day and my holiday to work. The power line to the station was put back about noon. We had no kite flights on powerless days because the kite reel was powered by an electric motor. Whether pilot balloon ascensions were made I don't remember but I suppose they were. We did put up a sounding balloon that day and lost it.

Weather recording instruments besides the clock-motor instruments were powered by a bank of wet cell storage batteries, so the records were uninterrupted.

On April 16, 1931, occurred one of the breakaways about which I recorded a fair amount. This description is taken from my diary, not quite verbatim. We had a big flight, out to 10,500 meters. When the first kite was landed at 4,000 meters (that is, we'd reeled in 6,500 meters of wire) the wire broke, taking away the remaining four kites, one of them holding my camera. Just the night before I had made my latest improvement on it. The boys--as I expressed it--found the kites caught in a tree out at Billey's farm with three in the air. Before they got there the kites had acted up some. When one of them dived to the ground the wire, thus brought low, came onto the back of one or more horses pulling a grain drill. The wire was singing, as usual. The horses ran away with the drill, spilling sacks of grain off of it, tore through a new fence, broke a pole on the drill and scratched up one horse. The boys tied the three kites, the wire, that is, onto the truck and flew them back to the station, leaving for the time being the one which had fallen into the Maple River after its rope was tied to a tree. They got back about 4:30 and I finished the flight which had been up since 6:59 a.m. by landing the head kite at 5:14 p.m. My camera on the second kite had not touched the ground, so it was all right. I was done at 7:20 after spending about 13 hours at the station.

Six days later we had another breakaway, apparently without serious trouble. There was no typical breakaway; each one was different.

On June 25, 1931 there was again a very pleasant day except for mosquitoes. We started a flight at 11 a.m. Charles L. and I got back to the station at 12:15 p.m. after our morning's work, to relieve the men on the flight. The kites broke away at 12:19, four of them. They went NE. Collet's phoned to us that they were at their place. Charlie H. and I started pulling and collecting kite wire when Tom and Donny left for lunch. We were clearing up the wire strung out over the countryside. Tom and Donny came with the truck to where Charlie

and I were working. We pulled wire up by the G. N. R. R. track and left it there. Then we went to Collet's. I wish I could remember where these farms were and at what distance, but I cannot now.

The kites had broken away again. We found one a complete wreck about a mile north of Collet's, so we dragged it till we got to the place of Guss, north of there. The folks there helped us discover the kites about 3 miles northwest of that place. We left the wreck and went to the other kites by a very round-about way through fields and such. They were flying from a fence post west of the Skoda place. A youngster told us how to get to them and he went along. He and his brother and three sisters had caught the kites before one kite hit the fence and had tied them up, two still in the air.

We tied the wire to the truck and took a course down through a ford in the Maple River near there. We had to pass the kites across and run the truck over. Donny and Charlie got shocks from the static electricity on the wire when they crossed the stream. All this time of course the kites were still flying. We had to send Donny back to the station to help with the pilot balloon run, and since it was then 5 o'clock we tied the kites to a post a mile south and some distance east of there and I took Donny in, with Charlie and Tom staying there. When we got to Ellendale, we had a flat tire, so Donny left for the station and I changed the tire. I had to walk to my home and back up town to the truck because I'd left at home my keys to open the spare tire lock. When I got the tire changed and went to the station, the balloon run was over so Donny went back with me at 6 p.m. When we got back to the kites which were anchored about $1\frac{1}{2}$ miles east of the highway and south of the Maple River and Soo R. R., Tom and Charlie and Donny went up to the corner by Keller's grove to an eat-and-drink stand to get something to eat. Not caring to go, I went down to the stream for a swim to wash and cool off. It was so shallow I swam only a couple of strokes, but got to feeling more comfortable. When the boys came back, we hauled the kites home. We had to cross 11 telephone lines on the way but had no trouble. Good, strong pull all the way kept the kites up nicely. We got back at 9 p.m. rather tired. We spliced on, reeled in, and fought mosquitoes with a smudge on the ground until after 10. I worked up the flight and got home at 11:20, after 16 $\frac{1}{2}$ hours from the beginning to the end of my day.

Crossing telephone lines, a common part of recovering breakaways, involved a fairly simple, though sometimes difficult procedure. Not so very well remembered after four and one-half decades, I believe it went like this: We drove along a

road, or a field if that's where it started, until the telephone line was in our way. Then we threw one end of a rope over the line from one side to the other. The other end of the rope was already fastened to the kite wire at some height above the place where the wire was fastened to the truck for towing. Next, we drove the truck a little farther along under the line, tightened up the rope we had thrown over, and detached the towing connection. Then, when we had the towing end of the kite wire beyond the telephone line in the direction we were going, we refastened it to the truck, let out slack on the rope we'd used to make the transfer over the line and proceeded on our way. Eleven such crossings took some time.

Some fairly hot weather came that summer. On July 15, 1931 the previous record of 103° was exceeded by a reading of 105° , and 108° on the 25th. Then 102° on the 26th and 106° on the 27th. In later years this was exceeded considerably but at the time we thought it was hot. Incidentally, the lowest on record there, to my knowledge, is -39° at some time when I was not in Ellendale.

In January 1932 we were closed in again to some extent by snow. On January 11, some of us skied out to work as hard snow blocked the roads. On the 17th we had to leave the truck in the middle of the pasture across which we had made our way, and walk to the station. After getting it free once, driving it to the station and back to town, we left it. I skied to and from work some in the next two days. On the 19th most of us shovelled and plowed a road to the station with a wedge plow we had made, pulled by the truck. This sort of difficulty continued for several days, plowing through once or twice more, as the drifting went on.

January 29 of that year was an unusually severe day with temperature 8 to 15 below zero and a 20 to 30 mile wind and snow. The Milwaukee R. R. had to separate its train to get through from Aberdeen, South Dakota. On the 30th the temperature was -23° and the train then was stranded in Monango, north of Ellendale. The wrecker sent out to relieve it was derailed south of Ellendale. Hard drifts blocked highways and railroads and put us out of communication by those means. The railroad rotary plow did get through about 5 a.m. the next day, which was Sunday. The mail was brought through by curious means. The Friday mail, the last to come through, contained no eastern mail, as the train from the East had not got to Aberdeen soon enough. The Sunday mail usually came by bus, but the bus was not running. The Ellendale postmaster, Mr. Saunders, was on his way home from Minot, North Dakota, and had been stopped at Oakes, North Dakota,

northeast of Ellendale. He had gotten to Aberdeen and was coming up north to Ellendale on Sunday with the mail carrier substituting for the bus carrier.

Some men from Ellendale were on their way to get Mr. Saunders, but both northbound and southbound cars came to a place a few miles south of Ellendale where they couldn't get through. But since Mr. S. was the postmaster, he could allow the mail to be brought by the men on the north side of the divide as long as he accompanied it. So the mail was carried across the snowy barrier and three days' mail arrived at its destination without the substitute carrier having to go all the way.

On August, 1932 we started cooperating in the International Polar Year observations. The successor to this project was the International Geophysical Year 25 years later in 1957 and 1958. Presumably there will be another such project in 1982 and 1983.

Our part in this scientific study was, among other tasks, to put up unlimited-height sounding balloons in sets of three ascensions at certain times each month for 13 months. At 1 p.m. and the following 1 a.m. and 7 a.m. we were to launch a sounding balloon with a meteorograph capable of recording conditions in the stratosphere, much above the level of our limited-height balloons. This was to be done at two times each month. Then we were to observe all solar and lunar phenomena of the atmosphere and aurora borealis, meteors and so on that came to our notice. This went pretty well except for returns of the meteorographs. Returns were very few.

There was a total solar eclipse in New England, about 65% of totality in Ellendale, on August 31. We took special climatological observations for several hours at short intervals during the eclipse.

September 10 to 17, 1932 was the time of our especial thrill and pride. At that time the noted physicist and Nobel prize winner, Dr. Robert Millikan was with us, and his associate, Ira S. Bowen. We were to help them launch into the stratosphere some cosmic ray electroscopes. They were to go up with our meteorographs, carried aloft by special balloons furnished by Dr. Millikan's scientific group. Success was not with us on that special occasion and the many people assembled from all around were disappointed, as were we. The crowd was there to see the first of the scheduled ascensions on ^{September} ~~August~~ 14. The wind was too strong and tore the balloons so that only one of the three ascensions could be made with four balloons which were furnished. And even that balloon was sent up three days later, after a frustrating try on the day before. There is much more I could tell about this. Dr. Millikan did not get to see the final successful launching, as he had left Ellendale by then. We were all extremely pleased with

the scientists themselves, and had great admiration for their fine spirit in the face of such adversity. Dr. Ira Bowen later on became director of the Mt. Wilson and Palomar astronomical observatories.

Skipping along in time past events of lesser interest, I make mention of the coldest condition of weather in my memory. On February 8, 1933 the wind was 25 to 30 m.p.h. and the temperature was -25° to -31° . We didn't have wind chill index tables then but one I have now says that the index of that condition would be about 90 ⁰ below zero. I happened to be off duty that day but was outside some of the day. I heard plenty about the kite flight and made a copy of the instrument record of that flight.

In June, 1933 I went to Pembina to conduct the airplane observation work there. We continued the IPY balloon ascensions and finished that program in August. One note of mine says that we received back from 9 ascensions at Pembina only two instruments with one good record.

Pembina weather and other experiences there would make another story, but of the weather, just this one remark. The temperature while I was there ranged from 102° to -35° .

Besides what I wrote before, there isn't much to say about the use of what I called the aerocamera on the kites. Its use gave me a great deal of satisfaction and the results were enjoyed by others as well.

More than a little could be said about the interest and enjoyment derived from the ordinary sights and sounds of the surroundings: the great flocks of migrating birds in season, the sky in all its appearances, sunsets and sunrises, interesting solar and lunar halos and arcs which I've seen nowhere else in such variety or frequency, the aurora borealis at night, the singing wires on telephone and telegraph lines near the reel house on very cold days, the bird songs, and so on.

Of the working conditions, it is worth mentioning that they were good, on the whole. Severe and rugged at times, but healthful in the main. Some outside work, some inside made for a pleasant variety and lack of monotony. New equipment and methods, experiments and improvements of our own devising gave us continual mental stimulation.

As more practical means were found to secure upper air data, the kites had to go. First the airplane observations with instruments similar to the kite meteorographs, then the radiosonde, which is still used, I think. Rockets, too, do some of this, though I know little of their use.

With aircraft so numerous and swift, the kites and wires in the air would be unacceptable for meteorological purposes. But, like those who have a feeling of nostalgia for the days of sailing ships and steam trains and windmills, some of us wish that kite flight meteorology might have continued.

H. Clark Fuller

February, 1976

FREE-AIR SUMMARY

By L. T. SAMUELS

In Table 1 the temperature departures for the month are inappreciable except for the highest levels, where a marked tendency toward plus departures occurs at all stations. Relative humidity departures were mostly small and those of vapor pressure were likewise of no special significance, the latter being in general of the same sign as those for temperature.

In Table 2 the resultant winds for Ellendale exhibit the most pronounced departures from normal. At this station there was a decidedly greater south component together with a higher resultant velocity than normally, particularly in the higher levels.

An exceptionally striking example of a very deep and strong ascending air current occurred at Ellendale on the 12th when the kite carrying the meteorograph became detached from the kite wire and immediately rose from an altitude of 1,750 meters to 4,900 meters above ground. The kite and instrument, together weighing approximately 18 pounds, rose as a free body throughout this 3-kilometer air column at the rate of 6.5 meters per second. The descent was at the rate of 4 meters per second. If we assume the effect of gravity alone and no descending current acting upon the falling kite, it is evident that the rate of the ascending current was approximately 10.5 meters per second. The meteorogram reveals a saturated condition throughout this air column and a temperature inversion at its top. The following is taken from the report of the official in charge at Ellendale:

A most unusual and exceedingly interesting action of the kites followed the breakaway on the 12th. The kites were being held at 2,200 meters awaiting the outcome of a thunderstorm cloud which had developed to the north and was spreading out toward the east and southeast. It appeared at first that our kites would be only in the extreme western edge of the rain area; however the cloud built up toward the west and enveloped the kites more than was expected. When it became apparent that we could not wholly escape the storm, we started to reel in. Three kites were flying, two above the clouds and at a high angle. The record shows the head kite was at an altitude of approximately 1,600 meters at this time. We had reeled in for seven minutes under a fluctuating pull, which reached 350 pounds when the break occurred. During the interval of reeling in the surface wind had veered sharply to N. from SSE., the wind aloft remaining unchanged. At 4:49 p. m. the break, or rather the two breaks, came in quick succession. The upper section of the kite wire, between the second and third kites, was evidently struck by a mild lightning discharge, for it was found blackened and distempered later. This weakened it so that a break occurred at about 1,000 meters releasing the two lead kites in a westerly wind. The lower kite now being free from the others, shifted into the north wind. The shift took place so abruptly that with the sudden release from the other kites slack was thrown in the wire, forming a kink near the reel where the second break occurred when the wire again became taut. This last kite, trailing over 600 meters of wire, then moved off toward the south and southwest and finally caught on a telegraph wire about 2 miles to the southwest of the station. From this mooring the wire lay across a high tension line carrying 13,200 volts. When we reached the place long sparks were shooting up the kite wire whenever it touched two of the high-voltage wires. The kite wire was soon burned through and the kite came to the ground. This kite and wire were then recovered and taken back to the station.

Upon our return to town a telephone call had come in from the east that a kite was about 15 miles ENE. of the station. We made a trip out after it the same evening over exceedingly muddy and rough roads, made so by the heavy rain which fell east of the station during the thunderstorm. This kite, the first secondary, with most of the remaining wire, was recovered the same evening. Darkness soon prevented further search for the lead kite that evening. It was recovered the next day about 4 miles west of where the other secondary was picked up.

The meteorograph record shows a most unusual action of the head kite immediately following the breakaway. The upper section of the kite wire after being struck by the mild discharge broke at about 1,000 meters. It is not definitely known, as the kites were above the clouds, but conditions point toward the fact that

the lead kite was at this time separated from the secondary, the break occurring at the swivel splice. This break was also apparently caused by weakened wire from the lightning discharge. The record shows that immediately after the break the instrument kite was actually sucked upward through the air and within a few minutes had reached an altitude of over 4,900 meters. This is by far the most amazing phenomenon I have ever encountered in connection with kite flying. Tremendous convection currents must have prevailed to cause such an ascent, for so long a period and through so much space, of an 18-pound kite and instrument. The record itself is unquestionable, both the pressure and temperature traces being quite true to form. The extreme height reached by the free kite was considerably more than twice that possible from the amount of wire out during the flight.

(Signed) L. A. WARREN, Meteorologist.

The data of this flight are given in the following table:

Time p. m.	Altitude (m) M. S. L.	Temperature	Δt 100 m.	Relative humidity	Vapor pressure	Wind	
						Direction	Velocity
		° C.			mb.		m. p. s.
3:23	444 (surface)	22.4		67	18.16	SE	5.8
	500	21.9		68	17.88	SE	6.0
	750	19.3		73	16.80	SE	6.3
3:33	783	18.8	1.06	76	16.50	SE	7.1
	1,030	16.4		81	15.11	SE	6.9
4:10	1,157	14.7	1.10	84	14.05	SSW	6.8
	1,250	14.2		89	14.42	SSW	7.7
4:14	1,296	13.9	0.58	92	14.62	SSW	8.1
	1,500	13.0		77	11.33	SSW	8.7
4:22	1,845	11.6	0.42	65	8.88	W	9.7
	2,000	10.4		87	10.97	WSW	11.0
4:28	2,043	10.1	0.76	93	11.49	WSW	11.3
4:44	2,199	9.2	0.58	93	10.83	W	11.1
	2,500	7.9		93	9.90	W	
	3,000	5.9		94	8.72	W	
	3,500	3.8		95	7.62	WSW	
	4,000	1.7		96	6.62	WSW	
	4,500	-0.4		96	5.67	WSW	
4:54	4,908	-2.1	0.42	97	4.99	WSW	
	5,000	-1.5		97	5.24	WSW	
4:55	5,279	0.4	-0.67	97	6.10	WSW	
4:56	5,331	0.3	0.19	97	6.05	WSW	

It will be noted that the lapse rate from the ground to 1,157 meters (M. S. L.) exceeded the adiabatic for dry air while that *within* the cloud through which the break-away kite was carried upward equaled the adiabatic rate for saturated air at the existing temperatures and pressures. It is evident that the convection in this case was extremely pronounced throughout an unusually deep layer, and although the lapse rates were sufficient to induce convection yet they were not greatly in excess of the respective adiabatic rates. This, however, should be expected from the fact that the observations represent conditions *within* the ascending column, whereas the lapse rates existing just previous to the vertical movement of the air in this region were probably even greater than those observed. While only a trace of rain fell from this storm at Ellendale it will be seen from Mr. Warren's report that *heavy* rain fell just east of the station.

Altitude (m.) M. S. L.	26th			27th		
	Temperature	Wind		Temperature	Wind	
		Direction	Velocity		Direction	Velocity
	° C.		m. p. s.	° C.		m. p. s.
141 surface	19.8	N	4.5	19.5	SSE	8.0
250	18.8	NNE	12.7	18.7	SE	8.3
500	19.3	NE	13.6	16.9	SSE	9.1
750	17.6	NE	13.9	16.1	SSE	11.7
1,000	15.8	NNE	14.2	15.6	SSE	14.5
1,250	16.0	NNE	15.3	14.7	SSE	16.5
1,500	17.8	NNE	17.6	13.8	SE	18.4
2,000	16.3	NNE	16.8	12.0	SE	18.4
2,500	13.4	NE	15.4	12.7	SW	19.2
2,723	12.1	NE	14.8	11.6	SW	19.5

In connection with the tropical hurricane which reached the Louisiana coast on the 26th, the free-air

6.5 m.p.s. = 14.5 mi. per hr.

4 m.p.s. = 8.9 " " "

$$m.p.s. \times 2.2369 = m.p.h.$$

$$1750 \text{ meter} = 5741.5 \text{ ft.} = 1.087 \text{ mi.}$$

4903 " = 16076.1 ft. = 3.04 mi.

5331 " = 17500 ft., approx. = 3.315 mi.

April 19, 1928.

On the 18th snow, rain and sleet had fallen, leaving objects coated to about $\frac{1}{8}$ inch with ice and the ground with about .2 inch of snow and sleet. The ground being warm, it was noticed that ponds were still open and the ground wet at 20° to 16° above zero in the late afternoon. With evening the sky cleared and the temperature went down to 12° above by six a.m. on the 19th. The wind, which had been from the North, was light in the a.m. and by early afternoon was very light and changeable. About 9 a.m. it began to cloud up some, with cumulus, but the sun was beginning to thaw the snow off the ground and by afternoon with a temperature of about 25° to 27° and no wind the whole country was steaming with vapor, especially from the plowed fields. (Continued on page 24)

On August 12, 1926 Thomas Lawler and I were making an afternoon kite flight at the Ellendale Aerological Station. We had three kites out, 500 and 1200 out to the last two. We had 1800 meters out and a rainstorm in the North shifted and came in from the NW, enveloping the upper two kites. The wind, formerly from the SSE, shifted to W and the kites held the ~~to~~ wire straight up. We started to reel in but the pull jumped to over 300 lbs. and we had to reel very slowly. A snap came and we couldn't see any wire so we thought it had broken but the next moment there it was again, jerked up from the ground apparently, but now it was off the first wheel and had a kink. We reeled up to the kink and the wire broke when it encountered the space between the wheel fork and the hub. It showed a red spark when it broke at 4:49 p.m. The kite drifted in a NE wind to the telegraph and high line wires S. of town and when we got there it was across the telegraph and two high tension wires letting out sparks 2 or 3 feet up the wire at 13200 volts. It broke as we got there, burned off, and drifted

about a mile S.W. where we recovered it, about 2 miles S & W of town. We had a call from Guelph and went out to Fred Haying's place to get the other kites three mud all the way from $1\frac{1}{4}$ miles E of town. A terrific rain had prevailed there in the afternoon. It was about 15 miles to the place. The next day the head kite was located at Minard's farm N.E. of Silverleaf about 8 miles away. The record showed that it had been sucked up from about 1200 to 4200 meters, about 2 miles in six ~~to~~ minutes and landed about 30 minutes after it broke. The wire from both of the N.E. kites showed the effects of lightning. Our theory was: The two top kites had been severed by lightning at the time of the first snap, letting the wire fall to the ground. They had become separated, each going its separate way and landing. This record showed beyond doubt that there are powerful ascending air currents in thunderstorms and this stands as a record for all to know that the kite was carried up to a

height of about $2\frac{3}{4}$ miles in a thunderstorm and was carried a considerable distance. The other hill might show even a more wonderful record if it had had an instrument in it. It barely sprinkled in town that day but a cloudburst was reported at Edgeley, 26 miles N. of town. The voltage before it broke was far above the 10,000 volt meter. see p. 25

(Apr. 19, 1928 cont'd)

Not only was the vapor ~~not~~ noticeable but also the whirlwinds showing as it did ~~very~~ plainly the effect of air currents created in a like condition of temperature and wind. In one field there were dozens of these whirls small and large, tho none were violent as an ordinary summer whirlwind. Most of them were of small diameter and carried the vapor twisting and whirling to heights of several hundred feet - one seemed near a thousand. This was kept up until the sky was clouded over again about 2:50 p.m.

Description fails to show or tell how extraordinary was this effect, I have never heard of anything equalling it. After the first hour of it the fields, exclusive of plowed ground, were not noticed to give off any vapor but for miles one could see the tall white, snake-like columns of vapor reaching into the sky showing an almost absolute calm for hundreds of feet into the air, as the balloon run showed at the time.

(Aug. 12, 1926, cont'd from p. 21)

Central Office official study of this flight gave these figures:

The rise was from 1750 meters to 4900 meters above ground immediately, then to 5331 meters. About 2200 to 4900 meters in 10 minutes at 6.5 m.p.h. vertical speed or about 14.5 miles per hour.